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ABSTRACT

The scores of the Scholastic Aptitude Test (SAT) have been declining since 1963. While this decline has occurred, scores on achievement tests administered to students in grades 3 to 11 have been stable. An alalysis of the medical and epidemiological literature was conducted to determine whether there could be a health factor that might have caused this situation. Nutrition, drugs, genetic and prenatal conditions, labor and delivery, child development, health status, and health care over several decades in the United States were reviewed. It was concluded that the decline in SAT scores has probably not resulted from disease or from the physical environment. A number of bibliographical references are appended. (Author/EVH)

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Could There Be a Medical Basis for the Declining SAT Scores?

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The problem. The Scores on the Scholastic Aptitude Test (SAT) of the College Entrance Examination Board have been declining since 1963. The total decline has been about 16 percent (to 1975). While this decline has occurred, scores on achievement tests given students from grades 3 to 11 have been stable. The question posed was:

Could there be a health factor that might have caused this situation?

The author's initial reaction was to doubt that there could be, but because the College Board was completing a substantial investigation of the problem, it seemed desirable to have an objective appraisal from a health perspective. The following analysis was completed in approximately six weeks.

Methodology. Documents were provided by the College Board that summarized reports of other task forces. Only one specific question on health was posed: "Could an increased use of induced labor in pregnancy have caused sufficient brain damage among the test-taking population to be a factor in the declining SAT scores?"

We consulted with others and reviewed the medical and epidemiological literature including that on nutrition, drugs, and environmental factors that could have affected infants, children, and adolescents. The technical appendix and bibliography contain a summary of our findings and a list of some of the trends noted in five developmental and related areas.

We particularly examined secular trends in child-development, nutritional patterns, health status, and health care, but found gaps and definitional problems in the published data that necessitated estimations and adjustments in national data. Health care and health status data had not been collected and published in a systematic manner in the United States before 1958, and since then only in specific categories defined by the then-created National Center for Health Statistics (NCHS). In general, the NCHS study categories did not relate to child development issues until the early 1960s and when they did, the critical time period (1945-62) was not investigated in a manner very useful for this report. In the six weeks' period available for our investigation, a picture was imperfectly developed. It is unlikely, however, that a longer time would have produced more. When we conclude, however, that no ecological factor could account for the SAT score decline, there is a certain sense of viewing the problem through a glass darkly.

Before beginning the investigation, a frame of reference was developed that considered the biological reasoning used to determine the direction of the investigation.

Biological reasoning. Four conditions seemed necessary and sufficient before a causal hypothesis regarding the declining SAT scores could be considered seriously. Whatever the nature of a putative health condition, it most likely:

1. Would have occurred in childhood, and have been subclinical in type. If not, it would have been described in the clinical medical literature and recognized as a "medical condition" previously.
2. Would be widely distributed in the United States population because of the numerical size of the test group.
3. Would have begun around 1945-46 since most test takers are 17-18 years old, and the first observed decline was apparent after 1962.

4. Would have gradually increased its influence over the next 15 years because the decline continued, subtly but continuously from 1963 to the present.

5. Would not have affected achievement test takers in grades 3-11 during the recent past.

Disease vs Environment

If the SAT decline were health related, it would virtually have to be environmental (ie., social or physical or both) leading to widespread, progressive, but mild deterioration in measured cognition.

Biological factors tend to be expressed as clinical entities in varying degrees of intensity within population groups. At this time, there are no established diseases that could have had this widespread subtle effect without also producing a recognizable gradual increase in serious cases. Such disease has not been described in the literature. It is concluded, therefore, that it would not be likely for a disease process to have caused a progressive change like the SAT decline.

We have reviewed environmental factors with particular references to their potential impact on brain development during the last trimester of pregnancy and through the first 18 months of life. We have extended the inquiry through childhood as well.

With respect to the question about induced labor in pregnancy we conclude that it is unlikely to have caused the decline. Despite induction's known hazards, the decline in SAT scores does not reflect a practice that was limited to a small proportion of babies delivered each year.

The inconsistency in results from achievement tests for grades 3-11 in comparison with SAT scores also makes it extremely unlikely that there was a biological basis for the SAT decline. Any biological process capable of producing the latter would also be reflected in earlier intellectual impairment.

It is concluded from this analysis that there were no known biological or environmental factors that met the criteria established earlier in this report. Thus, the decline in SAT scores is not likely to result from physical environmental factors.

Alternate explanation. From an epidemiological perspective, the most likely alternative explanation to a disease-oriented or an environmental hypothesis is a change in the test taking population itself. If, for example, the level of education of the parents of the test-taking population were to have declined parallel to the SAT score changes, the SAT decline would not be surprising.

TECHNICAL APPENDIX

This section includes five parts; each provides a brief summary of the medical conditions, the environmental factors, and the demographic factors that were reviewed in the preparation of this report.

A bibliography is attached.

Genetic factors. Genetic disturbances can jeopardize life or cause metabolic, structural, and intellectual deficiencies. Unfortunately, in the United States, as well as in other countries, birth defects have not been consistently recorded on birth certificates. Moreover, the incidence of genetic diseases in infants' families have rarely been linked to birth outcomes. In general, the incidence of congenital defects in the United States has been declining. Infant deaths resulting from defects decreased between 1954 and 1963. In New York State, for example, in the years 1950 through 1960, the number of malformations dropped from 14.28 to 11.44/1,000 live births. The three major central nervous system anomalies (anencephalus, spina bifida, and hydrocephalus) have shown the greatest reduction. Mongolism (Down's Syndrome) experienced a slight increase in New York State (31 to 48/1,000,000 births, 1950-58).[1] However, in 1959 the extra chromosome associated with Down's Syndrome[2] was identified. Its incidence has since decreased, perhaps because of the application of genetic screening procedures. Good data could not be found for any changing incidence of diseases such as maternal diabetes or sickle cell anemia for 1945-63. Death rates because of diabetes (an important disease of pregnancy)[4,5] however, have been dropping since 1948.

Prenatal factors. Most health indicators for the prenatal period improved during 1945-1963. Complications of pregnancy and childbirth that can jeopardize the fetus accounted for fewer maternal deaths in 1963 than in 1945 (35.8 vs. 186/100,000 live births). Those attributed to sepsis, toxemia, ectopic pregnancy, and spontaneous abortion also decreased. Maternal deaths from hemorrhages rose somewhat (3.0 to 6/100,000 live births).[1] Fetal deaths from diseases and conditions of pregnancy dropped in New York State, 1953-60 (115 to 86). Deaths related to toxemia of pregnancy fell from 143 to 20 but those from other toxemias rose from 17 to 69. (This may be a result of changing classifications.)

The optimum demographic profile of a potential mother is one of a woman aged 20-34, who is married, high-school educated, over 5'4" tall, who has been non-pregnant for two years.[1] During the period 1945-60, there has been a steady decline in births to women over 40, and an increase in the percent of live births occurring in women aged 20-34.[4] The percent of illegitimate births has increased from 4.1 to 7.7% (mostly because a greater proportion of women are unmarried). The median number of school years completed by American women rose from 9.0 to 11.8 (1940-60).[16] The height of American women aged 15-44 appears to have increased by almost an inch (brining the mean height to 63.8"). Birth intervals narrowed to near two years in the 1950s, but have increased since then to almost three years. Family planning has been widely accepted since 1960, which allows more birth spacing. Although lower IQ has been shown to be associated with family size, its consideration is beyond the scope of this report.

Maternal malnutrition during pregnancy can impair fetal growth. During this period, the American diet included increased amounts of protein and carbohydrates but the sources changed. Milk, whole grains, and fresh fruits and vegetables declined in per capita consumption. There is no reason to believe that this shift in food sources has had any detrimental health consequences -- in fact, most studies suggest the

nutritional status of children is improving. However, the practice of restricting weight gain during pregnancy was prevalent during 1950-70, and this may have contributed to problems associated with low birth weight infants.[10] Although low birth weight babies have lower IQ test performance as late as ages 8-10,[2,3] it does not seem sufficiently prevalent to link it to the SAT test decline.

Exposure to toxic substances are recognizable risks to fetal development. The practice of taking drugs during pregnancy was relatively common before 1963. A 1960 study by the Kaiser Permanente found 90 percent of pregnant women had taken a prescription drug.[12] Not until the thalidomide tragedy of 1963 did this matter become a public concern.[6] Another study showed that 27 percent of all women having live births in 1963 had an X-ray during pregnancy -- the majority for nonpregnancy-related reasons.[9] Smoking mothers tend to have low birth weight babies more frequently.[15] From 1955 to 1966 the proportion of women aged 18 to 44 smoking more than one package of cigarettes a day more than doubled. In addition the general incidence of women smoking in the child bearing years increased from roughly 35 to 40 percent.[15] Streissguth found that children of alcoholic mothers had more borderline to moderately retarded children by age 7 than controls (75 percent vs. 22 percent) regardless of education and even when raised in excellent foster homes.[13]

In the case of these toxic substances, however, the possible subtle forms of brain injury are not known, if they do actually exist. It seems highly unlikely that individually or collectively they could account for the pattern of change observed in the SAT test scores, and not affect achievement test scores for grades 3-11.

Labor and delivery. During the period 1945-70, many obstetrical practices, since changed, were in effect. In 1967, at least one third of all deliveries were under general anesthesia, and this frequently produced overnarcosis of the newborn. Nearly nine percent of all deliveries were electively induced. In the 1960s use of forceps peaked. There has been marked improvement in the prevention and management of Rh-factor babies.[2]

Neonatal mortality rates declined between 1950 and 1960. Those attributed to birth injuries dropped from 3.2 to 2.4/1,000 live births. The decline was primarily among normal weight infants. However, neonatal deaths from postnatal asphyxia and atelectasis increased from 3.6 to 4.5/1,000 live births.[4] However, all of the increase occurred in low birth weight babies. Since 1950 plural births (associated with more traumatic deliveries) have decreased, primarily because of the younger age distribution of mothers.[5] (Plural births tend to occur to older women.)

Declining death rates do not necessarily indicate improvement in health status. As Hellman stated: "If many babies actually die from hypoxia or trauma, during birth, it seems likely that many others escape death, but suffer permanent effects of cerebral injury. The late effects of birth injuries, both hypoxic and traumatic, are among the most important problems that require urgent and intensive study in modern obstetrics.[1,3] We do not, however, have reliable estimates of the numbers of infants so affected.

The number of in-hospital and physician-attended births increased to its present level between 1950 and 70.[6] Thus, any consequences or

disadvantages of modern medical care should now be fully apparent. Any long term health implications from these changed practices have been primarily in more intensive care for high risk infants, whose survival rates did not change appreciably between 1950 and 1965.

Infancy. Low birth weight has been associated with two to three times the risk of physical defects and higher mortality. Three longitudinal studies showed at ages four, six to nine, and eight to ten that IQ was directly proportionate to birth weight regardless of social class. Among blacks, the percentages of low birth weight babies increased in the United States from 1950 to 1967. Median birth weights of whites have been stable.[6] Low birth weight infants born between 1961 and 1968 may, however, be faring better than those born earlier. They have experienced less mutual retardation, blindness, and deafness.[3]

The brain grows most perinatally and in the first two years of life. In the years 1945-65, breast feeding declined in popularity.[5] Evaporated milk was the most commonly used infant food until 1963 when the use of commercially prepared formulas became widespread.[7] Evaporated milk is higher in protein, carbohydrate, calcium, phosphorous, and vitamins D, B1 and B2 than is human milk, and lower in vitamins A, E, C, and B6, as well as iron and zinc. Also, evaporated milk must be diluted to the protein level of human milk to be digested by infants.[4] It is unlikely, however, that these changes were important neurologically, because of compensatory sources of nutrition available to American infants.

Childhood. The health of American children (ages 1-14) improved steadily between 1945 and 1960. Childhood mortality (ages 1-14) decreased between 1945 and 1955 (127.1 to 69.6/100,000 children). Deaths attributed to meningitis, influenza, gastrointestinal problems, heart disease, rheumatic fever, and accidents declined most strikingly. An increasing number of deaths were attributed to congenital malformations (4.9 to 5.8/100,000), leukemia (3.2 to 3.7), and other cancers (4.9 to 5.8).

Some other conditions seemed to increase in number, such as the measured prevalence of visual, hearing, and orthopedic impairments, perhaps because of improvements in screening. Speech defects, however, which have often been associated with mental development, had a declining prevalence in school children.[1]

Heights and weights of children increased through 1955-56 and have remained stable,[3] most likely attributable to better nutrition.

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